Between a Rock and a Hard Place: Conserving the Broad-headed Snake in Australia's oldest National Park

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The broad-headed snake (*Hoplocephalus bungaroides*) is recognised as one of the most endangered reptiles in Australia. This study examined the distribution of the broad-headed snake in Royal National Park in order to devise measures to conserve the species in this Park. Loose rock on rock outcrops provides vital shelter sites for the broad-headed snake. Surveys were conducted by searching under loose rock at 26 rock outcrop sites distributed throughout the Park. Sites were categorised as disturbed or undisturbed based on proximity to roads and walking trails which are extensive in the Park. Broad-headed snakes were found at nine sites, representing a significantly greater proportion of undisturbed sites. This suggests that the distribution of the snake was influenced by disturbance. Quantification of the loose rock habitat revealed little difference between disturbed and undisturbed sites. Thus, either the methods of quantification were inadequate or broad-headed snakes simply avoid sites classed as disturbed. Further studies are needed to assess ongoing habitat disturbance in this Park, to review all walking tracks that are located close to suitable snake habitat and to assess the feasibility of recovering sites that are presently disturbed.

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INTRODUCTION

The conservation status of Australian reptiles was recently reviewed (Cogger et al. 1993). Scores were given to species based on their population size, population stability, distribution, reproductive rate and ecological specialisation. The broad-headed snake (*Hoplocephalus bungaroides*) received a total score suggesting that it was the second most endangered snake in Australia. The availability of information required for the conservation of the species was poor and it was concluded that the species should have a high priority for research and monitoring (Cogger et al. 1993). Indeed, the species is accorded the highest conservation status by the New South Wales *Threatened Species Conservation Act* 1995 and is also listed by the Australian *Endangered Species Protection Act* 1992. It has been formally recognised as endangered in NSW since 1974.

The geographic range of the broad-headed snake is one of the smallest for an Australian elapid snake and is virtually confined to the region of the Sydney basin (Longmore 1989; Swan 1990; Cogger 1992). Within this region it is broadly distributed across many National Parks, including several of considerable size and some that are Australia's oldest. However, detailed information on the distribution of the broad-headed snake is absent and its presence within such conservation areas does not guarantee long term survival due to the close proximity of the greatest concentration of Australia's human population. The ultimate goal for recovery of the species is to ensure that viable populations are maintained across the reserve system (Cogger et al. 1993).

The broad-headed snake has become threatened due to habitat destruction caused by urban expansion, bush rock collection (Hersey 1980; Shine and Fitzgerald 1989) and possibly removal of hollow-bearing trees that provide summer retreat sites (Webb and Shine 1997a). Loose sandstone rocks on rock outcrops offer shelter to broad-headed snakes and their prey, and therefore comprise a vital habitat component (Hersey 1980; Webb 1996; Webb and Shine 1997b). Despite extensive collection of bush rock for garden ornamentation in areas around Sydney, neither the severity of this problem nor its solution is known. Natural replacement of this habitat component may take millennia (Webb 1996). Thus, studies on the species should document the availability of the loose rock habitat throughout its range.

Royal National Park, Australia's oldest National Park, was chosen as an example of a conservation reserve where the status of the broad-headed snake needs to be determined. This Park has been declared for over 100 years and has the greatest recreational use of any in which the snake occurs. Therefore, this Park should provide a good model for examining the management requirements of the snake. The present study aimed to: i) determine the distribution of the broad-headed snake in Royal National Park, ii) assess the influence of disturbance on the habitat of the snake, and iii) provide recommendations for the management of the snake in this Park.

METHODS

Study Area

This study was conducted in Royal National Park (Royal NP) which has an area of approximately 17000 ha. The Park is located about 24 km from the Sydney GPO and forms the southern boundary of the Sydney metropolitan area. Continuing urbanisation has virtually isolated the Park from other bushland areas; links with Heathcote National Park to the west are tenuous, as the two Parks are separated by the Princess Highway (and associated urban development along the western boundary) and by the Sydney-Wollongong Freeway along the south-western boundary. The eastern boundary is the coastline.

Royal NP consists of four broad habitat types: heathland, woodland, open forest and closed forest. Heathland is the most extensive habitat type in the Park with open forest dominating the gullies and ridges on the western and southern sides of the Park, and woodland occurring between these two habitats. Closed forest is mostly confined to the gully along the Hacking River. A wildfire in January 1994 burnt through about 95% of the Park (Whelan et al. 1996) with only the closed forest surviving unburnt.

Survey Sites

Areas that contained potential habitat for the broad-headed snake were identified from topographic maps and traverses of the Park. Selection of survey sites was based on the presence of rocky ridges, rock ledges or outcrops that contained loose rock and which had a north through to west aspect. These aspects are favoured by snakes as they receive the late afternoon sun during the cooler months of the year, which is beneficial to these nocturnal snakes (Webb 1996). Many sites contained disjunct patches of rocky habitat but the area searched at each site was approximately equal to a transect 200 m x 30 m. Sites devoid of any loose rock were not chosen. Adjacent sites were chosen only if they were separated by at least 300 m.

A total of 26 sites were identified as appropriate for survey. A further 14 sites were examined but could not be used because they were virtually devoid of loose rock (probably due to past anthropogenic disturbance). Sites were chosen to adequately represent

Figure 1. Disturbance of the loose rock habitat — indicated here by a rock pile apparently constructed by hikers.

two broad habitat types, forest and woodland-heath (an ecotone between woodland and heath), where broad-headed snakes have been recorded previously. Forest was represented by 15 sites and woodland-heath by 11 sites. All sites were affected by the 1994 fire.

All sites were placed into one of two categories (disturbed or undisturbed) based on their potential for disturbance. Disturbed sites were arbitrarily defined as those that were located within 300 m of a road or walking trail. The long period of recreational use of the Park (>100 years) may make it more difficult to recognise more than the most obvious signs of rock disturbance (e.g. camp fires), so an operational definition was needed. However, this definition is consistent with the criteria used by Schlesinger and Shine (1994), based on several types of recognisable disturbance to a rock outcrop (see Fig 1). The present definition could be applied objectively and allowed consistency through time, so that intermittent disturbance to outcrops during the survey period would not require that they be switched to a different category. Because of the high public use of the Park and its age (dedicated in 1872), most sites were placed in the disturbed category. A total of 17 disturbed and nine undisturbed sites were identified for surveys.

There are a number of factors that could affect the presence of snakes on rock outcrops other than the level of habitat disturbance. The main factor appears to be temperature. Radio-tracking studies of broad-headed snakes approximately 100 km south of Royal NP established that the cooler months of the year are the most appropriate time to look for snakes sheltering under loose rock (Webb 1996; Webb and Shine 1997b). Thus, surveys of outcrops were only conducted between late April and mid-September. Even within this period, temperatures varied substantially and may have influenced the detection of snakes. Also, it was not known whether rain would affect the use of loose rocks by snakes, so surveys were not conducted during periods of heavy and continuing rain. To maximise the chances of detecting snakes a survey strategy was employed whereby every site was sur-

veyed on three different occasions, with a minimum of 2 weeks between repeat surveys at the same site. Surveys were conducted between April 1995 and July 1997.

Surveys consisted of walking through a site and searching for snakes under loose rock by one or two people. Care was taken to ensure that the same rocks were not searched twice when two people were present. Rocks that lay on a rock base were the focus of the survey. Rocks that were embedded in the soil, located in wet areas or which did not lay flush with the substrate were not considered suitable. Many rocks in these categories (>100) were lifted during the survey but were never found to conceal broad-headed snakes. No attempt was made to search adjacent rock crevices. Several factors were recorded during each survey of a site: the time taken to survey the site (the elapsed time multiplied by the number of people searching), the total number of suitable rocks that were lifted, the number of these rocks that sat neatly on a bare rock substrate (>50% bare), and the number of reptiles encountered under the rocks. Only rocks of >10 cm length were included. All snakes found under rocks were captured, measured, and for broad-headed snakes, given a small but distinctive cut on the ventral scales so they could be identified if recaptured.

Habitat Measurements

The availability of loose rock was quantified in two ways. Firstly, the number of rocks turned during each site survey was recorded. The number counted in each survey was averaged over several surveys at a site. This was done because it was not possible to precisely mark out a survey transect at each site, nor was it known whether the number of rocks at a site would change temporally. Secondly, the abundance and size distribution of rocks at each survey site were sampled in three quadrats, each measuring 5 x 10 m. These measurements were made at each site during the latter part of the snake survey. The method for this followed that of Schlesinger and Shine (1994) but differed in a few respects. The quadrats were placed at each end and in the middle of the survey area. The length, width and thickness of all rocks >10 cm diameter were measured and the number of these rocks that lay directly on a rock substrate was counted.

RESULTS

Snake Survey

Each of the 26 sites were surveyed three times. Broad-headed snakes were detected at seven forest sites and two woodland-heath sites (Table 1). This result shows that the broad-headed snake could be found in each habitat type, and that all sites could be used to examine the influence of habitat disturbance. There were nine sites categorised as undisturbed (U) and 17 sites categorised as disturbed (D). The amount of time (min) spent searching sites was equivalent ($t=0.67$, $P=0.51$) for both categories (mean±s.e.; U = 28.0±3.2, D = 25.6±2.0). Broad-headed snakes were located at five of the undisturbed sites and two of the disturbed sites following three surveys to each site; this distribution was significantly dependent on the disturbance category ($G=5.61$, $P<0.025$). A broad-headed snake was also found at disturbed site C in 1994. A fourth survey was made to four of the forest sites and a broad-headed snake was detected at one undisturbed site (H) where none had been detected in the three earlier surveys. In contrast, the small-eyed snake (*Rhinoplocephalus nigrescens*) was detected at 10 of the 26 sites (Table 1), and its distribution was independent of disturbance category ($G=1.68$, $P>0.1$). Six of the sites in which broad-headed snakes were located during the three visits were located in the southern part of the Park. However, separate analysis of these data showed a significant influence of site disturbance on the distribution of broad-headed snakes ($P<0.02$) but not on small-eyed snakes ($P>0.75$).

TABLE 1

Snake survey data for Royal NP. Habitat was Forest (F) or woodland-heath (W), and disturbed (*) or undisturbed. Values (except BHS, SES) are means of three repeat surveys. Rocks = the number of rocks turned; good = the number of rocks sitting on a rock substrate; BHS = broad-headed snake; SES = small-eyed snake. Values for BHS and SES show the number of snakes for each of 3 surveys (values in brackets are snakes detected outside the 3 surveys). Geckos and skinks are the number encountered under rocks.

Site	Habitat	Time (min)	Rocks	Good	BHS	SES	Geckos	Skinks
AA	F*	24	49	27	0/0/0	0/0/3	6.3	0.7
A	F	36	43	15	1/0/0	1/0/0	3.0	0.7
B	F*	22	34	8	0/0/0	0/1/1	0	0
C	F*	20	25	5	0/0/0 (1)	0/0/0	0	1.3
D	F*	43	67	21	0/0/0	0/0/1	3.3	0
E	F	19	24	11	1/0/0	0/0/0	0	0.3
F	F	49	82	18	0/0/0	1/3/0	5.0	0
G	F	26	45	18	0/1/0	1/0/0	1.0	0
H	F	17	31	10	0/0/0 (1)	1/0/0 (2)	0.3	0.3
I	F	26	54	13	1/0/0	2/0/0	1.3	0.7
J	F	26	52	13	0/1/0	0/0/0	0.7	0.7
K	F*	30	37	9	0/0/0	0/0/0	2.3	2.0
KK	F*	21	47	13	0/0/0	0/0/0	1.0	1.0
L	W*	14	15	7	1/1/0	0/0/0	1.3	0.3
M	W	27	68	16	0/0/0	0/0/0	1.3	1.7
N	W*	25	56	15	0/0/0	1/0/0	0.7	0.7
P	W*	41	65	20	0/0/0	0/0/0	1.7	0.7
Q	W*	29	53	12	0/0/0	0/0/0	0.3	0.7
R	W*	20	38	8	0/0/0	0/0/0	4.0	2.0
S	W*	30	51	19	1/0/0	0/0/0	2.3	0
T	W*	21	70	19	0/0/0	0/0/0	1.0	0.7
U	F*	19	58	20	0/0/0	0/0/0	0.3	0
V	W	26	69	14	0/0/0	0/0/0	2.7	2.0
W	F*	37	62	19	0/0/0	0/1/0	5.3	2.3
WW	W*	16	48	11	0/0/0	0/0/0	0.7	0.3
Y	W*	23	69	21	0/0/0	0/0/0	4.7	0.3

Broad-headed snakes in all but one instance chose rocks that had a dry, bare-rock substrate underneath. The rocks (n=11) varied from 3–11 cm in thickness (mean±s.e., 6.4±0.7 cm), from 46–134 cm in length (70.4±7.4 cm) and from 30–67 cm in width (43.1±3.9 cm). Small-eyed snakes chose rocks that often contained soil and leaf litter underneath and although similar in thickness, the rocks were smaller in size to those of the broad-headed snake. These rocks (n=13) were 2–11 cm (6.0±0.6 cm) in thickness, 22–83 cm (50.5±4.7 cm) in length and 17–46 (32.6±2.5 cm) in width.

Loose Rock Habitat

The availability of rocks surveyed varied among sites from 24 to 82 (Table 1). The number of rocks that had a rock substrate underneath varied from 5 to 27 among sites. When these values are averaged over site categories, the total number of rocks surveyed at the undisturbed sites (52.0±6.2) was equivalent (t=0.34, P=0.74) to that surveyed at the

disturbed sites (49.6±3.8). The number of rocks with a rock substrate that was surveyed at the undisturbed sites (14.2±0.9) was equivalent to that at the disturbed sites (14.9±1.5).

The data recorded from the three 5 x 10 m quadrats were also consistent with the above data on rock abundance at each site (Table 2). The total number of rocks per three quadrats was equivalent at undisturbed sites (29.8±1.3) and disturbed sites (31.6±2.3). A similar number of rocks sitting on a rock substrate was counted at undisturbed sites (7.8±1.5) and disturbed sites (8.7±1.0).

TABLE 2

Rock habitat measurements at each site. * = disturbed sites. Total rocks = the number counted in three 5 x 10 m quadrats. Suitable thickness = the number of rocks within the range (3–11 cm) selected by broad-headed snakes. Suitable LxW = rocks within the range of length (46–134 cm) and width (30–67 cm) selected by snakes. Suitable LxWxT = rocks with suitable length, width and thickness. Values in brackets show the number that were sitting on a rock substrate.

Site	Total Rocks	Suitable Thickness	Suitable LxW	Suitable LxWxT
AA*	40 (7)	27 (4)	7	4 (2)
A	31 (10)	26 (9)	6	6 (2)
B*	39 (7)	29 (4)	8	4 (0)
C*	21 (6)	15 (3)	3	3 (2)
D*	33 (5)	31 (5)	1	1 (0)
E	29 (8)	22 (5)	9	6 (2)
F	28 (9)	25 (8)	8	8 (2)
G	36 (18)	30 (15)	10	10 (7)
H	33 (2)	30 (2)	5	5 (0)
I	28 (6)	25 (5)	3	3 (1)
J	33 (6)	28 (2)	5	5 (1)
K*	32 (15)	31 (15)	3	2 (1)
KK*	46 (20)	41 (18)	7	5 (5)
L*	20 (4)	17 (3)	2	2 (1)
M	26 (4)	23 (4)	2	2 (0)
N*	37 (10)	35 (9)	3	3 (2)
P*	26 (5)	23 (4)	4	4 (2)
Q*	31 (6)	25 (6)	3	2 (1)
R*	20 (7)	18 (6)	9	8 (3)
S*	17 (4)	14 (2)	2	2 (0)
T*	31 (10)	28 (9)	12	11 (6)
U*	32 (11)	28 (9)	6	5 (2)
V	24 (7)	19 (7)	5	5 (3)
W*	24 (10)	15 (5)	4	2 (1)
WW*	47 (10)	42 (9)	1	1 (1)
Y*	41 (11)	34 (9)	9	9 (1)

The dimensions of rocks selected by broad-headed snakes (including 6 adults and 3 juveniles) were used to devise an index of rock suitability at each site. It was assumed that the ranges in rock size (see above) reflected a size preference by snakes. Comparing the numbers of rocks within the thickness range of those selected by broad-headed

snakes revealed no difference between undisturbed sites (25.6±1.4) and disturbed sites (26.4±2.0). If only those within this grouping that had a rock substrate are counted, the number of rocks potentially preferred by broad-headed snakes was not different at undisturbed sites (6.6±1.5) compared to disturbed sites (6.9±1.0).

The abundance of rocks at each site within the range of length and width selected by snakes was compared from the quadrat data (Table 2). This showed that the number of rocks was greater for undisturbed (5.9±0.9) sites compared to disturbed sites (4.9±0.8) but the difference was not significant ($t = 0.75$, $P = 0.46$). Comparing those in this group that also had the appropriate thickness revealed no significant difference ($t = 1.36$, $P = 0.18$) between the undisturbed sites (5.6±0.8) and the disturbed sites (4.0±0.7). The number of rocks in this group with a rock substrate was equivalent between the undisturbed sites (2.0±0.7) and the disturbed sites (1.8±0.4).

Availability of Potential Prey

The number of lizards seen under rocks was quite variable across all sites (Table 1). A lower number of geckos (*Oedura lesueurii*) was recorded at undisturbed sites (1.7±0.5) compared to disturbed sites (2.0±0.5) but the difference was not significant ($t = 0.49$, $P = 0.63$). The number of small skinks (various species) was equivalent between the undisturbed (0.7±0.2) and disturbed sites (0.8±0.2).

DISCUSSION

Snake Distribution

The broad-headed snake like many endangered vertebrates is not an easy animal to study due to its rarity. This necessitated devising a standard survey method that could be applied in any area where information on relative abundance and distribution was required. Three visits to a site with suitable habitat was arbitrarily chosen and reflected a trade-off between survey intensity at a site, and the number of sites to be surveyed. Snakes were found at sites during the first or second survey except in two cases when they were found outside the three surveys. Thus, two searches several months apart may suffice when a general index of presence or absence is needed. Weather conditions are likely to influence the detection of sheltering snakes. Dry sunny conditions the week before and during the survey appeared the most appropriate.

Although the locations of broad-headed snakes were distributed quite broadly across the Park, there was a concentration in the southern part of the Park. This may reflect either a greater expanse of forest, which has been suggested to be the snake's preferred habitat (Swan 1990), or may reflect lower levels of disturbance. Roads and walking tracks tend to be located in gullies in the southern part of the Park but close to ridges in the northern part of the Park. However, data analysis revealed that broad-headed snakes in the southern part were significantly influenced by site disturbance while small-eyed snakes were not.

The detection of single broad-headed snakes at eight survey sites (two were detected at a ninth site) suggests that either the density of snakes was extremely low or that lifting of rocks at a site created disturbance that the snakes avoided. Although the latter cannot be ruled out, it is likely that the snakes were at very low density in Royal NP given the extensive area and large number of rocks surveyed. This low density could be the result of recent wildfires in the snake's habitat. Broad-headed snakes often use tree hollows as retreat sites during summer (Webb 1996; Webb and Shine 1997a), making them vulnerable to summer wildfires. This could have led to the death of many snakes in January 1994 when fires swept through 95% of the Park. Low reproductive and growth rates (Webb 1996) would keep their abundance at low levels for many years.

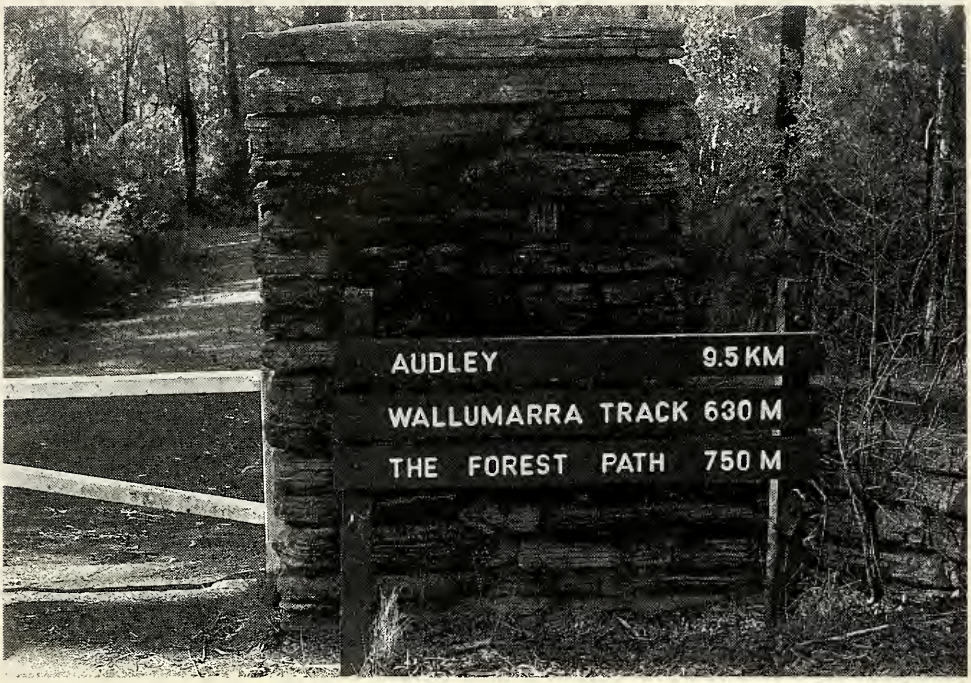

Figure 2. The gateway marking the southern end of Lady Carrington Drive constructed last century from loose rock of a size suitable for broad-headed snakes.

Habitat Disturbance

There was an influence of disturbance on the distribution of the broad-headed snake. Other studies have suggested that disturbance of its habitat may result from bush rock collection for garden ornamentation or from logging (Shine and Fitzgerald 1989; Schlesinger and Shine 1994; Webb and Shine 1997a; Shine et al. in press). These forms of disturbance may be of less concern within well-patrolled National Parks like Royal NP. Interestingly, several historic rock walls in the Park are constructed from rocks approximating the dimensions of those preferred by broad-headed snakes (Fig. 2). This may explain the dearth of loose rock at some of the 14 sites rejected from inclusion in this study.

Disturbance of the habitat of the broad-headed snake is extensive within Royal NP, has multiple causes and is an ongoing process. One disturbed site where a snake was observed was vandalised by the construction of two small rock gardens for growing cannabis. One undisturbed site was in the process of being vandalised in a similar way when visited for the third survey. The people responsible reported displacing a snake resembling a broad-headed snake at the former site. A walking trail adjacent to another disturbed site had been partly constructed from loose rock suitable for snakes. In yet another area, such rocks had been used to form a drainage channel. Disused camp fires constructed with such rocks were seen at several sites.

The influence of disturbance on the measured variables of the loose rock habitat was not strong. The number of rocks did not differ between disturbed and undisturbed sites. When the dimensions of rocks selected by snakes were considered, the undisturbed sites contained only marginally more of the "preferred" rocks than the disturbed sites. Snakes may simply avoid sites where human recreational activities are at a high level

such as would be predicted for the disturbed sites. The rarity of broad-headed snakes at disturbed sites could also be a result of snake collectors that removed broad-headed snakes from easily accessible sites. The latter explanation is quite likely given that this species is valued by amateur herpetologists in Sydney (Hersey 1980; Shine et al. in press) and that Royal NP was a well-known collecting site (J. Webb pers. comm.). Recolonisation of sites cleared of broad-headed snakes may be very slow due to their low reproductive and growth rates. This species gives birth to 1–5 young every 2–3 years (Shine 1983; Webb 1996).

Active management for the broad-headed snake should be given a high priority in Royal NP. However, few areas in the Park contain undisturbed habitat. Many areas of suitable habitat are either traversed by walking trails or in close proximity to walking trails. Hence, protection of the broad-headed snake's habitat will always be difficult. Given that this snake is critically endangered it is not realistic to ignore its management requirements in this National Park no matter how small the local population of snakes might be.

Management of Broad-headed Snake Habitat

Studies have found that thin (<15 cm thick) loose rocks exposed to direct sunlight are used extensively by broad-headed snakes during the cooler months of the year (Webb 1996; Webb and Shine 1997a). By choosing these rocks, snakes can remain active by maintaining their body temperatures within their preferred range (see Huey et al. 1989; Webb 1996; Webb and Shine 1998). This would allow snakes to feed over longer periods of the year to maximise their levels of growth and reproduction (Huey et al. 1989). In areas where loose rock has been destroyed, snakes may be forced into hibernation for a long period of the year which may restrict reproductive output. Thus, such areas may only be able to support low densities of snakes and their prey. This may have adverse consequences if maintained over long periods of time for isolated populations such as that in Royal NP. It is assumed that the time period for natural replacement of loose rock is millennia (Webb 1996). This indicates that active management of the snake's habitat is required.

An obvious outcome of the present study is the need to examine ongoing disturbance of the loose rock habitat within Royal NP. A short-term study should be initiated that provides an assessment of continued disturbance to the loose rock habitat. This could be done by establishing sites where loose rock is experimentally placed on rock shelves at disturbed and undisturbed locations. The locations of these rocks would be precisely mapped at the beginning and end (e.g. 12 months later) of the experiment. This would allow an assessment of the level of ongoing disturbance and an insight into the feasibility of recreating this habitat component to benefit the snakes. Such a study should also consider the potential to increase the abundance of the snake's prey species through managing the loose rock habitat.

Given the paucity of broad-headed snakes in Royal NP and the extent of ongoing habitat disturbance, similar surveys are now required in other National Parks around Sydney to examine the suitability of the habitat for this endangered species. This information is fundamental to conserving this species but presently no such information is available (Cogger et al. 1993). A recent study included many off-Park areas (see Shine et al. 1998). Surveys could establish a baseline of the distribution and abundance of the broad-headed snake that could be used by Park managers in future years to monitor the local status of the species. For example, the present study provides baseline data on the distribution of broad-headed snakes in Royal NP. It is recommended that surveys be conducted every five years at fixed sites to provide an assessment of the status of the population. Such a frequency should minimise any disturbance caused by these surveys but consideration should be given to whether such surveys have an impact on broad-headed snakes.

Given the low reproductive rate of the broad-headed snake, the loss of snakes to either wildfire or snake collectors will have a severe impact on population stability. The extensive use of tree hollows by broad-headed snakes in summer (Webb and Shine 1997a) necessitates consideration of active fire management to protect snake habitat from summer wildfires. Control fires in buffer zones or burning snake habitat in the cooler months when snakes are not in tree hollows should be considered. It is not clear at present how to protect snakes from collectors but this may be achieved by ensuring that rock outcrops are not too accessible. The present study found that snakes were more frequently detected at undisturbed sites, demonstrating the need for active management to ensure such sites remain undisturbed. A comprehensive review of all walking trails with some rationalisation such as the closure of particular walking tracks will be needed. It may also require specific fire management to promote dense vegetative growth near tracks to discourage hikers from walking beyond track boundaries. A program of public education should be initiated in Royal NP to increase public awareness of the vulnerability of this snake to habitat disturbance (e.g. to discourage construction of camp fires). This could be used to encourage reporting of people who may interfere with the snake's habitat.

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